MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

DEE5036 – DIGITAL FUNDAMENTALS

(Diploma in Electronic Engineering)

29 FEBRUARY 2020
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **5** pages (excluding the cover page and appendix).
2. Answer **ALL** questions. All necessary working steps must be shown.
3. Rules of Boolean algebra is provided in the Appendix section.
4. Write all your answers in the answer booklet provided.

QUESTION 1 [25 Marks]

a) For the given signed numbers below, answer the following questions:

$$01001110_2, 11100001_2$$

(i) Convert both numbers into its equivalent decimal.

[4 marks]

(ii) Add the two numbers in 2's complement form. State whether overflow occurs or not.

[3 marks]

(iii) Subtract the two numbers in 2's complement form. State whether overflow occurs or not.

[4 marks]

b) Perform the mathematical operation of 189 + 727 in Binary Coded Decimal (BCD).

[6 marks]

c) Convert the Gray code 1011101010101 into its equivalent

(i) Hexadecimal
(ii) Decimal

[6 marks]

d) What is the importance of ASCII in digital communication system?

[2 marks]

Continued...

QUESTION 2 [25 Marks]

a) Referring to the logic circuit shown in Figure 1, answer the following questions.

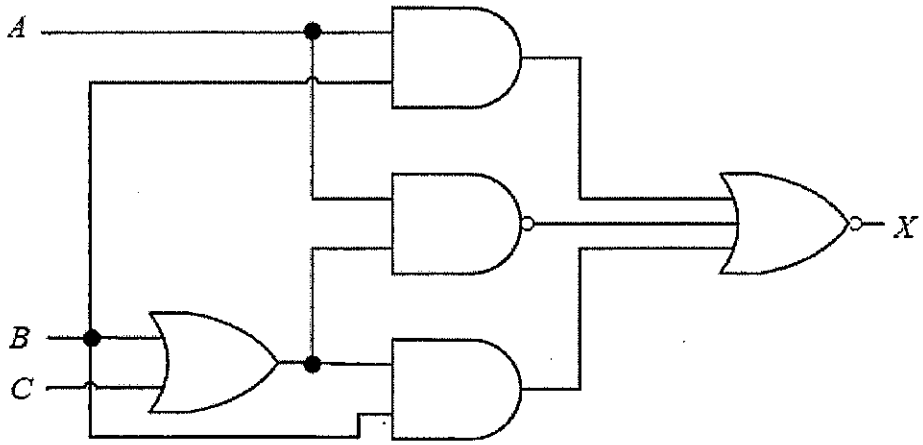

Figure 1

(i) State the logic expression for the output X.

[4 marks]

(ii) Provide the truth table of the circuit.

[8 marks]

(iii) Simplify the expression obtained in (i) using rules of Boolean algebra.

[8 marks]

b) A device consists of two switches and a LED. When only one switch is HIGH at a time, the LED will be turned ON. Otherwise, the LED will remain OFF. If ON is represented by the logic '1', and OFF is represented by the logic '0', create the truth table of the system.

[5 marks]

Continued...

QUESTION 3 [25 Marks]

Based on the given logic function below, answer the following questions.

$$W(P,Q,R,S)=\Sigma m(0,3,4,5,8,11,12)+\Sigma d(1,6,9,14)$$

a) Provide the minimized Sum-of-Product (SOP) expression using a Karnaugh map.
[8 marks]

b) Provide the minimized Product-of-Sum (POS) expression using a Karnaugh map.
[7 marks]

c) You are to suggest an additional don't care term to the given logic function, that may further simplify your answer in (a).

(i) Rewrite the logic function with the additional don't care term.
[1 mark]

(ii) Explain how your suggestion could further simplify your answer in (a) with the aid of a Karnaugh map.
[5 marks]

(iii) Implement the logic circuit for your answer in (ii) using NAND gates only.
[4 marks]

Continued...

QUESTION 4 [25 Marks]

a) Design a block diagram for a circuit to perform 2's complement of an 8-bit signed binary number. Let the 8-bit signed number input labeled as A_n, and the 2's complement of the number labeled as B_n, where n = 0, 1, 2, ..., 7. You may use 8-bit parallel adder for the design, and any logic gates if needed. Label all inputs and outputs of the diagram.

[8 marks]

b) The timing diagram shown in Figure 2 are the inputs of a 2-to-4 multiplexer circuit, where S_1 and S_0 are the selector bits, and D_0 to D_3 are the data inputs. Draw the output waveform of the multiplexer.

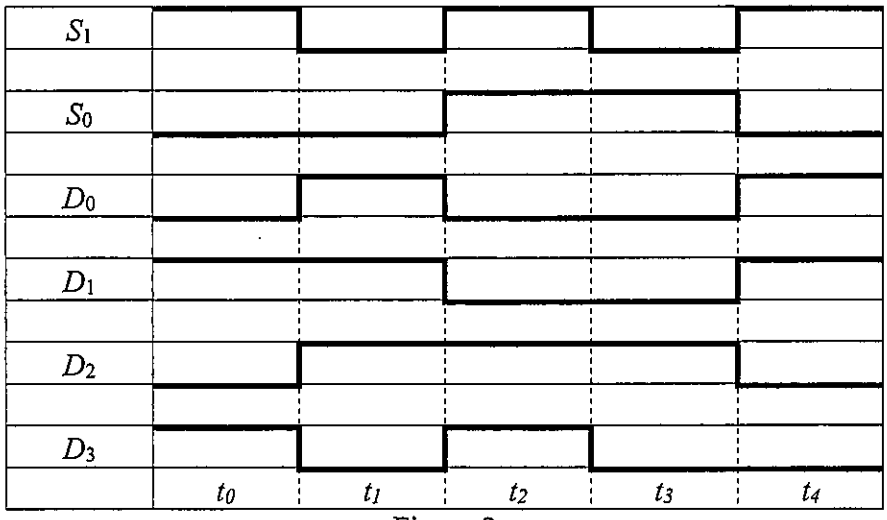

Figure 2

[5 marks]

c) State the reason which causes the output of an active-high *S-R* latch is invalid when both inputs are HIGH. Explain your answer with the aid of the logic circuit of an *S-R* latch shown in Figure 3.

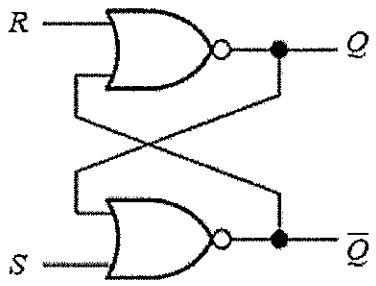

Figure 3

[6 marks]

Continued...

d) Draw the logic symbol of a negative-edge triggered *J-K* flip-flop.

[2 marks]

e) Draw the waveform outputs of a negative-edge triggered *J-K* flip-flop, based on the given input waveforms shown in Figure 4. Assume the flip-flop is initially LOW.

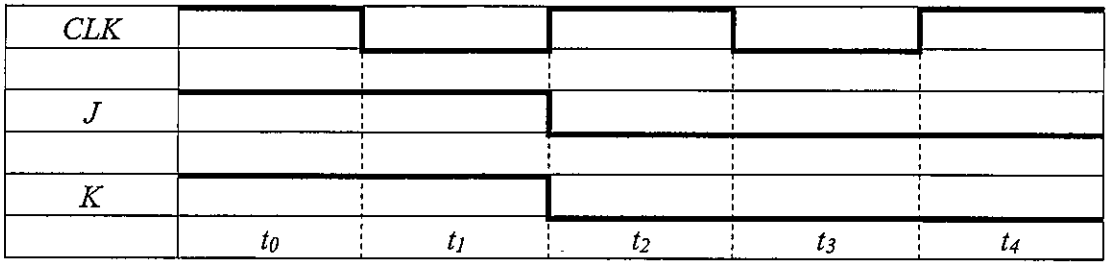

Figure 4

[4 marks]

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APPENDIX: RULES OF BOOLEAN ALGEBRA

1. $A+0=A$
2. $A+1=1$
3. $A\cdot 0=0$
4. $A\cdot 1=A$
5. $A+A=A$
6. $A+\overline{A}=1$
7. $A\cdot A=A$
8. $A\cdot \overline{A}=0$
9. $\overline{\overline{A}}=A$
10. $A+AB=A$
11. $A+\overline{A}B=A+B$
12. $(A+B)(A+C)=A+BC$